SITE CONDITIONS TECHNICAL MEMORANDUM
June 1998 Groundwater Sampling Results
Frontier Hard Chrome
Vancouver, Washington

Prepared for
U.S. Environmental Protection Agency
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ARCS QUALITY ASSURANCE CONCURRENCE

Site Conditions Technical Memorandum
June 1998 Groundwater Sampling Results

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SITE CONDITIONS TECHNICAL MEMORANDUM
JUNE 1998 GROUNDWATER SAMPLING RESULTS
Frontier Hard Chrome Superfund Site
Vancouver, Washington

1. INTRODUCTION

This technical memorandum is a contract deliverable under the U.S. Environmental Protection Agency's (EPA's) Work Assignment No. 46-38-027N to Roy F. Weston, Inc. (WESTON®) under the Alternative Remedial Contracting Strategy (ARCS) Contract No. 68-W9-0046. This technical memorandum summarizes the results of monitoring well installation and groundwater sampling and analysis activities completed in June 1998 at the Frontier Hard Chrome (FHC) Superfund site located in Vancouver, Washington. Interpretation of the groundwater analytical results relative to potential natural attenuation mechanisms for hexavalent chromium will be presented in a subsequent document (i.e., an addendum to the Hexavalent Chromium Natural Attenuation Mechanisms technical memorandum [WESTON 1998a]) following receipt of analytical results for subsurface soil samples collected in May 1998.

2. FIELD ACTIVITIES

This work was performed in accordance with the procedures and methods specified in the Sampling and Analysis Plan (SAP) (WESTON 1997a) and the Final SAP Addendum No. 5 (WESTON 1998b). The services completed for this investigation consisted of installing, surveying, and developing three monitoring wells; and collecting groundwater samples from selected monitoring wells for chemical analysis of selected conventional water quality parameters, filtered Target Analyte List (TAL) inorganics, and total organic carbon (TOC).

2.1 Monitoring Well Installation

Three 2-inch-diameter PVC monitoring wells were installed between 27-29 May 1998 at the locations shown on **Figure 1**. Wells W98-20A, W98-21A, W98-21B were installed using air rotary drilling methods to depths of 27, 26, and 44 feet below ground surface (bgs), respectively. All three of the wells had 5-foot-long, 0.02-inch, slotted PVC well screens. Monitoring well construction details are summarized in **Table 1**. Soil boring logs and well completion diagrams are presented in **Appendix A**.

Previous attempts on 30 April 1998 to install the wells using hollow stem auger drilling methods were unsuccessful.

The wells were developed by overpumping (at approximately 2 gallons per minute) with a portable submersible pump and surging with a bailer on 1 June 1998. Well development data are summarized in **Table 2**.

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The three wells were surveyed on 8 June 1998 for horizontal and vertical locations relative to the North American Datum of 1983, 1991 adjustment (NAD1983[91]) and North American Vertical Datum of 1988 (NAVD88), respectively.. Well survey results are summarized in **Table 1**.

2.2 Groundwater Sampling and Analysis

Groundwater samples were collected from 15 selected monitoring wells on 16-17 June 1998. A list of the wells sampled and the sample-specific groundwater analyses is provided in **Table 3**. All groundwater samples were analyzed for filtered TAL inorganics, conventional anions (bicarbonate, chloride, nitrate, sulfate), selected field water quality parameters, and TOC. Samples for filtered (i.e., dissolved) TAL inorganics analysis were field filtered using flow-through-disposable 0.45 µm filters. The groundwater sampling procedures used during this investigation are documented in **Appendix A**. The laboratory data quality assurance/quality control reports are presented in **Appendix B**.

All laboratory analyses were performed by EPA's Manchester laboratory in accordance with procedures described in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA SW-846, 3rd edition; 1986).

Previous investigations (WESTON 1997b, 1998c) indicated that filtered hexavalent chromium concentrations ranged from 90 to 100 percent of unfiltered and filtered chromium values. Those results demonstrated that there is little significant difference between hexavalent and filtered chromium values and essentially all of the chromium present in groundwater is in the hexavalent form. Filtered total chromium rather than hexavalent chromium was analyzed because it is a much more reliable and economical chemical analysis and previous sampling indicated that over 95 percent of the total chromium in groundwater is hexavalent.

2.3 Investigation-Derived Waste Handling

Soil cuttings generated from well installation and soil boring activities were placed in eleven 55-gallon drums and held in the yard behind the Angeles Metals facility at 116 "Y" Street in Vancouver, Washington. Two composite soil samples were collected from the drummed soil and analyzed for toxicity characteristic leachate procedure (TCLP) metals; analytical results indicated that the soil was nonhazardous. The drummed soil (7,450 pounds) was then transported to the Hillsboro Landfill in Hillsboro, Oregon, by ADT Environmental Solutions, Inc., for disposal on 14 July 1998. The drums were subsequently cleaned and recycled by ADT.

Wastewater (814 gallons) generated from equipment decontamination, well development, and well purging was placed in a 2,400-gallon holding tank also located at the Angeles Metals facility. The wastewater was sampled and analyzed for TCLP metals; analytical results indicated that the wastewater was nonhazardous. The wastewater was then transported to the Oil Re-refining Company, Inc., in Woodland, Washington, by ADT Environmental Solutions, Inc. for treatment and recycling on 14 July 1998. The wastewater holding tank was subsequently cleaned by ADT and picked up by the tank vendor.

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No investigation-derived waste remains at the site.

3. RESULTS

3.1 TAL Inorganics

Groundwater samples from all locations were analyzed for filtered TAL inorganics. Inorganic results are summarized in **Table 4**.

3.1.1 Chromium

The highest concentration of filtered (or dissolved) chromium (23,100 µg/L) was detected in monitoring well W92-14A. Concentrations of filtered chromium greater than 50 µg/L (i.e., the Safe Drinking Water Act Maximum Contaminant Level for chromium) were detected in six of the nine "A" zone well samples and two of the six "B" zone well samples. The reported detection limit for chromium was 5.0 µg/L. The spatial distribution of filtered chromium in the "A" and "B" zone wells are shown in **Figures 2 and 3**, respectively.

Filtered chromium concentration trends between December 1997 and June 1998 are variable and poorly constrained because of differences in which wells were sampled during the two events and because of elevated detection limits in some of the December 1997 sample analyses.

3.1.2 Iron and Manganese

Filtered iron and manganese were determined in all of the groundwater samples. Filtered iron was detected in only three of the nine "A" zone well samples and one of the six "B" zone well samples; the detection limit for iron was 10 µg/L. The maximum detected iron concentration was 21.8 µg/L at well W85-7B; the maximum detected iron concentration in an "A" zone well was 11 µg/L at wells W85-6A and W92-16A. Filtered iron concentrations decreased or remained undetected at the locations sampled in both December 1997 and June 1998.

Filtered manganese was detected in eight of the nine "A" zone well samples and five of the six "B" zone well samples; the detection limit for manganese was 1.0 µg/L. The maximum detected manganese concentration was 7,080 µg/L at well W92-14A. Manganese concentrations in samples from any given location were very similar between December 1997 and June 1998.

Filtered iron and manganese concentrations for "A" and "B" zone wells are presented in **Figures 4 through 7**.

3.1.3 Other TAL Inorganics

Arsenic, beryllium, cadmium, lead, nickel, selenium, silver, and thallium were not detected in any of the samples. Antimony, cobalt, copper, and zinc were detected in less than four of the samples; the maximum concentrations of antimony (170 µg/L), cobalt (8.2 µg/L), and copper

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(34.6 µg/L) were detected in W92-14A. Barium was detected in all fifteen samples with a maximum concentration of 66 µg/L, also at W92-14A. Vanadium was detected in nine samples with a maximum concentration of 8.4 µg/L at W85-6B.

3.2 Conventional Anions

Bicarbonate alkalinity, chloride, nitrate, and sulfate were determined in all of the groundwater samples. Conventional anions results are presented in **Table 5**.

Bicarbonate was detected in all of the well samples at concentrations ranging from 72.4 to 165 mg/L and a median value of 100 mg/L. The maximum reported bicarbonate concentration was detected at well W92-14A.

Chloride was detected in all of the well samples at concentrations ranging from 1.65 to 11.3 mg/L and a median value of 5.13 mg/L. The maximum reported chloride concentration was detected at well W92-14A.

Nitrate was detected in all of the well samples at concentrations ranging from 0.111 to 3.58 mg/L and a median value of 2.42 mg/L. The maximum reported nitrate concentration was detected at well W85-1B.

Sulfate was detected in all of the well samples at concentrations ranging from 10.5 to 37.6 mg/L and a median value of 14 mg/L. The maximum reported sulfate concentration was detected at well W85-4. Sulfate concentrations for "A" and "B" zone wells are presented in **Figures 8 and 9**.

3.3 Total Organic Carbon

TOC was determined in the samples from the three newly installed monitoring wells. TOC concentrations ranged from nondetected (<1.0 mg/L) at W98-20A to 1.39 mg/L at W98-21B. TOC results are presented in **Table 6**.

3.4 Field Water Quality Parameters

The water quality parameters pH, temperature, dissolved oxygen, conductivity, and redox potential were measured in the field during groundwater sampling. The results of field water quality parameter testing are summarized in **Table 7**. Results for dissolved oxygen and redox potential were rejected and are not reported here because of problems with field measurement equipment and conflicting instrument readings (i.e., high dissolved oxygen concentrations with very reducing redox conditions).

The pH values measured in groundwater at the site ranged from 6.0 to 7.8 with a median value of 6.6; the lowest pH value was recorded in W85-3A. Conductivity in groundwater varied from 72 to 325 microsiemens (µS) with a median value of 210 µS.

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4. REFERENCES

EPA (U.S. Environmental Protection Agency). 1986 and updates. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA SW-846, 3rd Edition).

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WESTON. 1998b. Final Sampling and Analysis Plan Addendum No. 5, Frontier Hard Chrome, Vancouver, Washington. Prepared for U.S. EPA Region X by Roy F. Weston, Inc., Seattle, Washington, March.

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WESTON. 1997a. Sampling and Analysis Plan, Frontier Hard Chrome Remedial Design, Vancouver, Washington. Prepared for U.S. EPA Region X by Roy F. Weston, Inc., Seattle, Washington, January.

WESTON. 1997b. Site Conditions Technical Memorandum, Preliminary Data Collection, Frontier Hard Chrome, Vancouver, Washington. Prepared for U.S. Environmental Protection Agency Region X by Roy F. Weston, Inc., Seattle, Washington. June.

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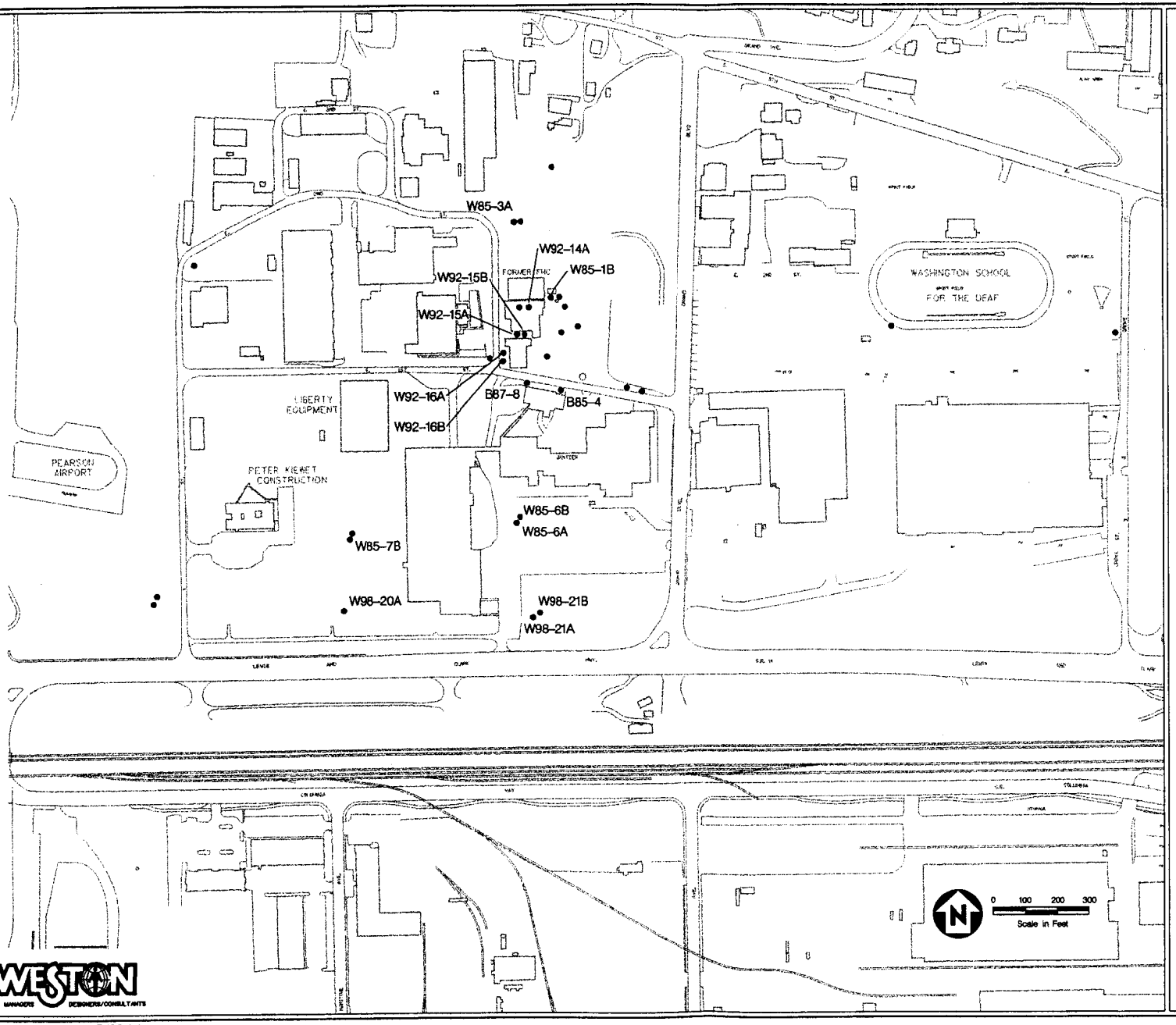
FIGURES



EXPLANATION

W85-3A • Monitoring Well

Frontier Hard Chrome
Groundwater Sample Locations
June 1998

FIGURE
1

WESTON
MANAGERS DESIGNERS/CONSULTANTS

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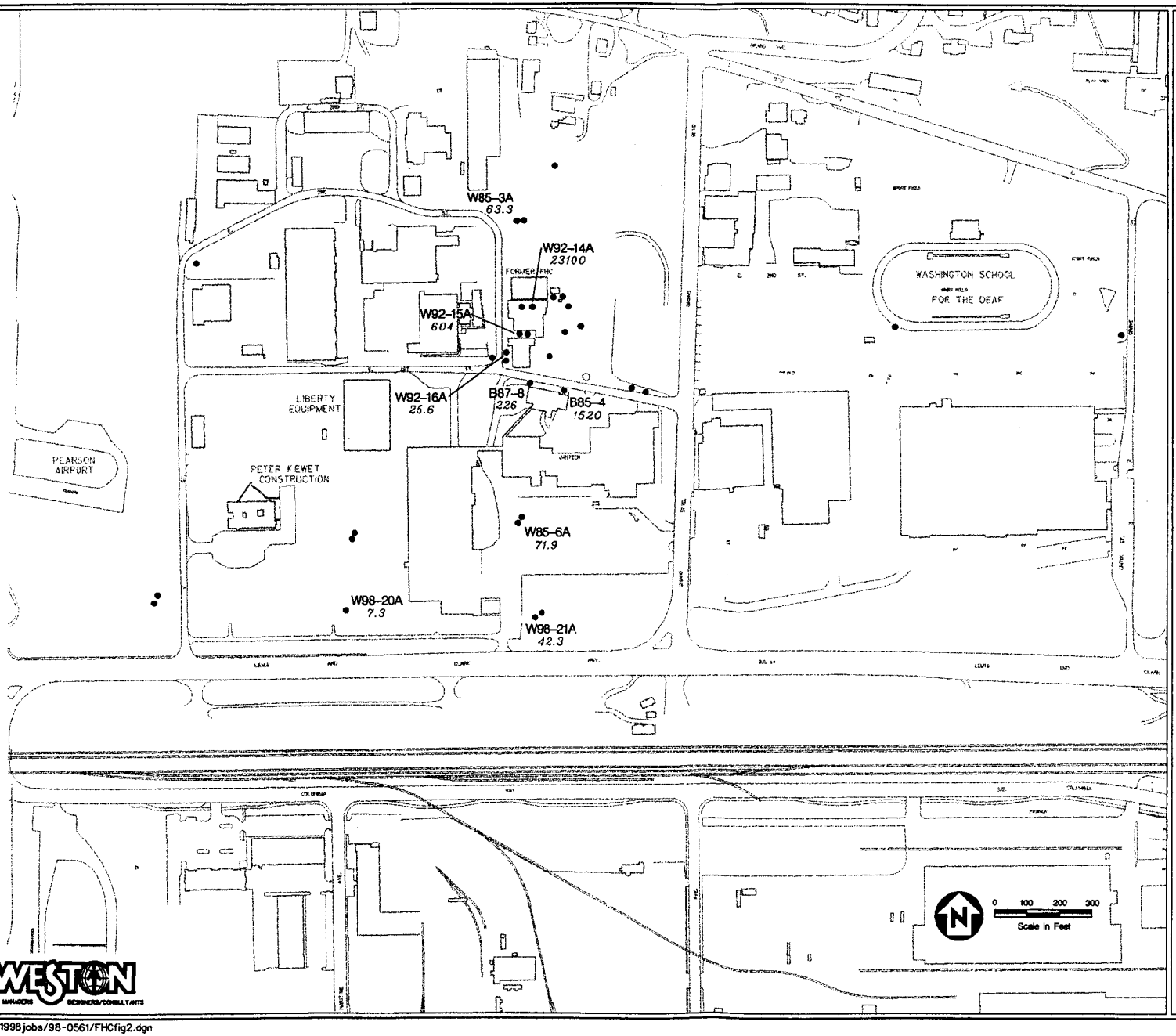

EXPLANATION

W85-3A
<10
Monitoring Well and June 1998 Filtered Chromium Concentration (ug/L)

Frontier Hard Chrome
Filtered Chromium Concentration
in Groundwater
"A" Zone Aquifer
June 1998

FIGURE
2

WESTON
MANAGERS DESIGNERS/CONSULTANTS

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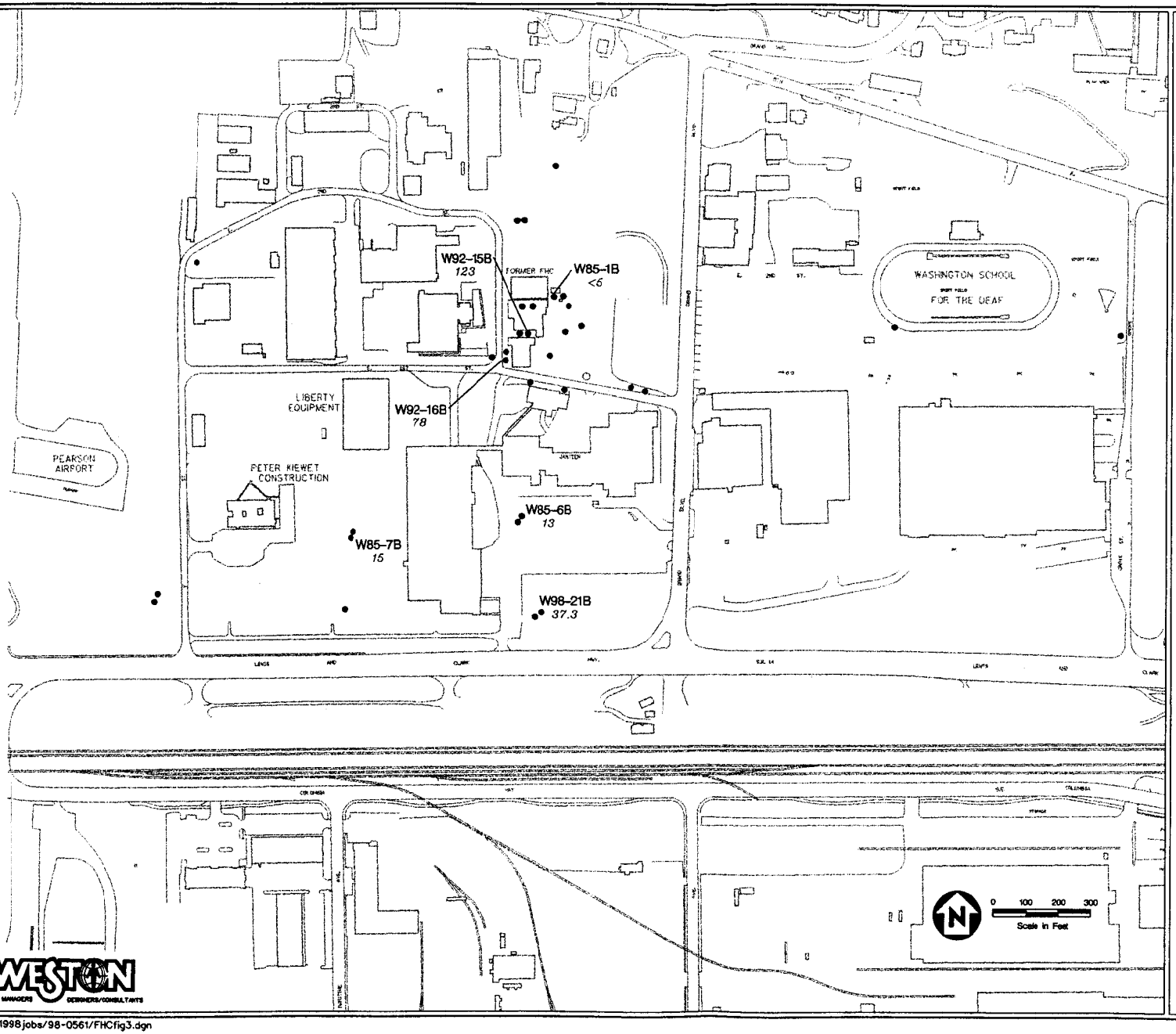

EXPLANATION

W85-7B
<10
• Monitoring Well and June 1998 Filtered Chromium Concentration (ug/L)

Frontier Hard Chrome
Filtered Chromium Concentration
in Groundwater
"B" Zone Aquifer
June 1998

FIGURE
3

WESTON
MANAGERS DESIGNERS/CONSULTANTS

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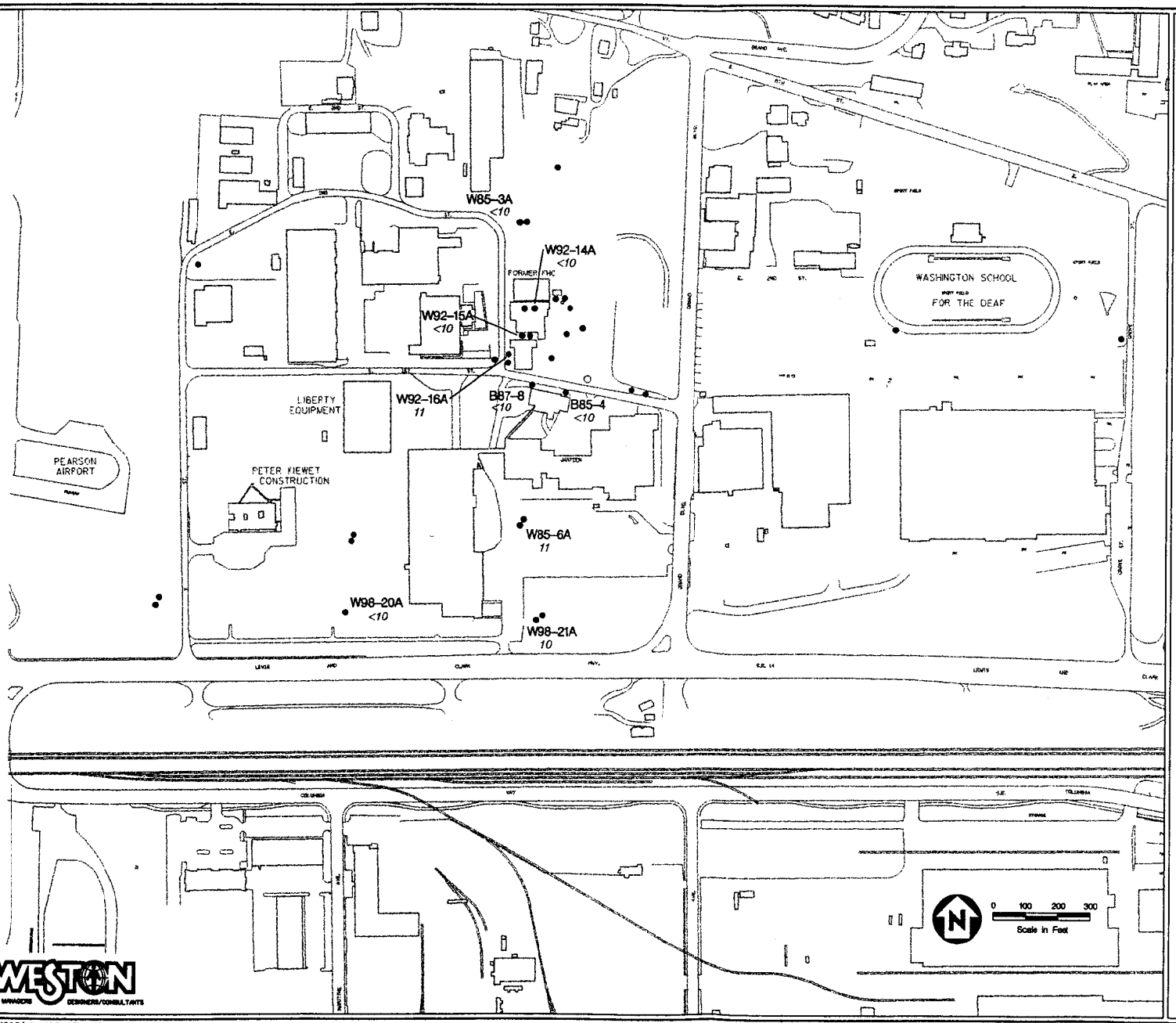

EXPLANATION

W85-3A
<10 • Monitoring Well and June 1998 Filtered Iron Concentration (ug/L)

Frontier Hard Chrome
Filtered Iron Concentration
in Groundwater
"A" Zone Aquifer
June 1998

FIGURE
4

WESTON
MANAGERS DESIGNERS/CONSULTANTS

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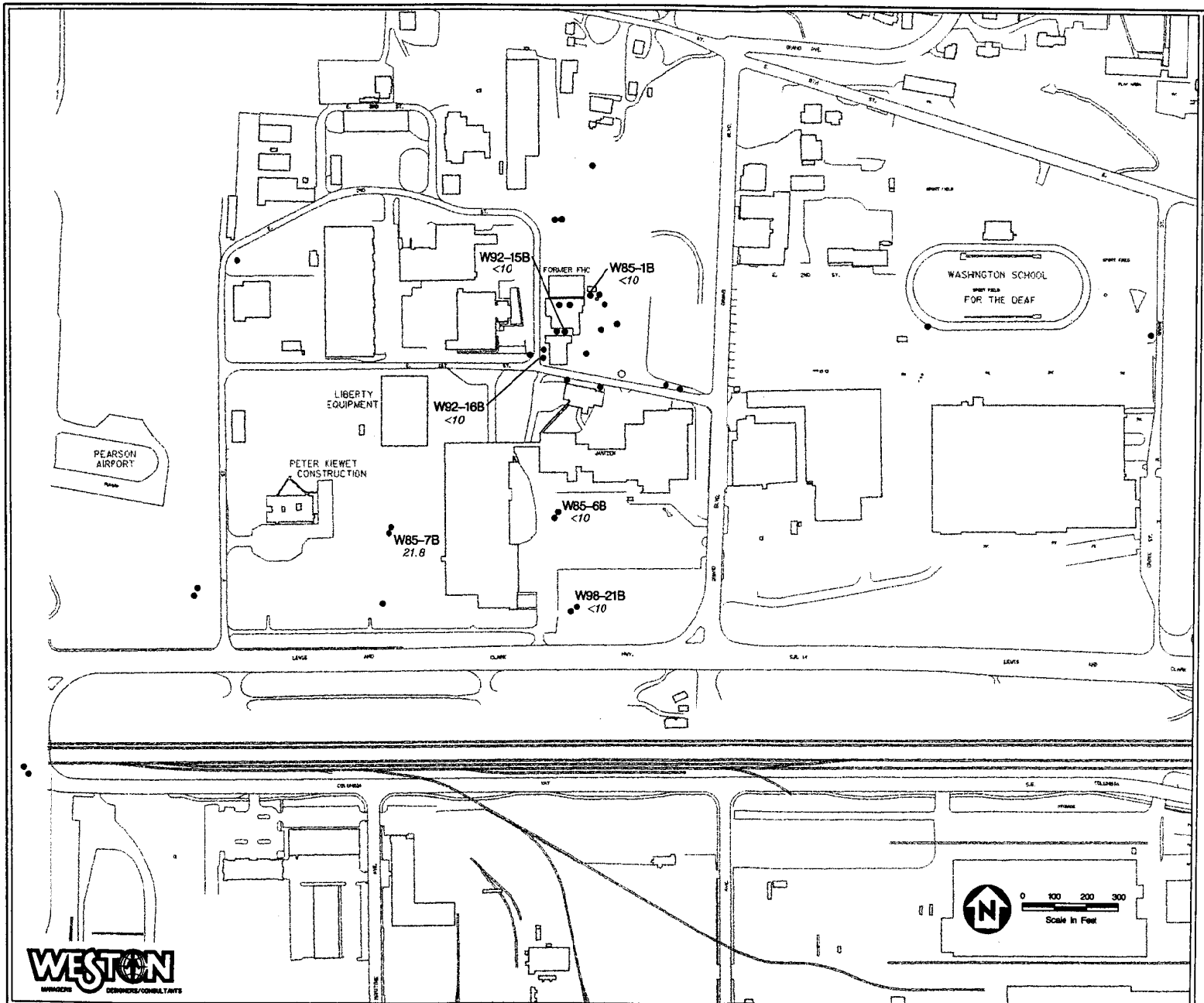

EXPLANATION

W85-7B
<10
Monitoring Well and June 1998
Filtered Iron Concentration (ug/L)

Frontier Hard Chrome
Filtered Iron Concentration
in Groundwater
"B" Zone Aquifer
June 1998

FIGURE
5

WESTON
MANAGERS DESIGNERS/CONSULTANTS

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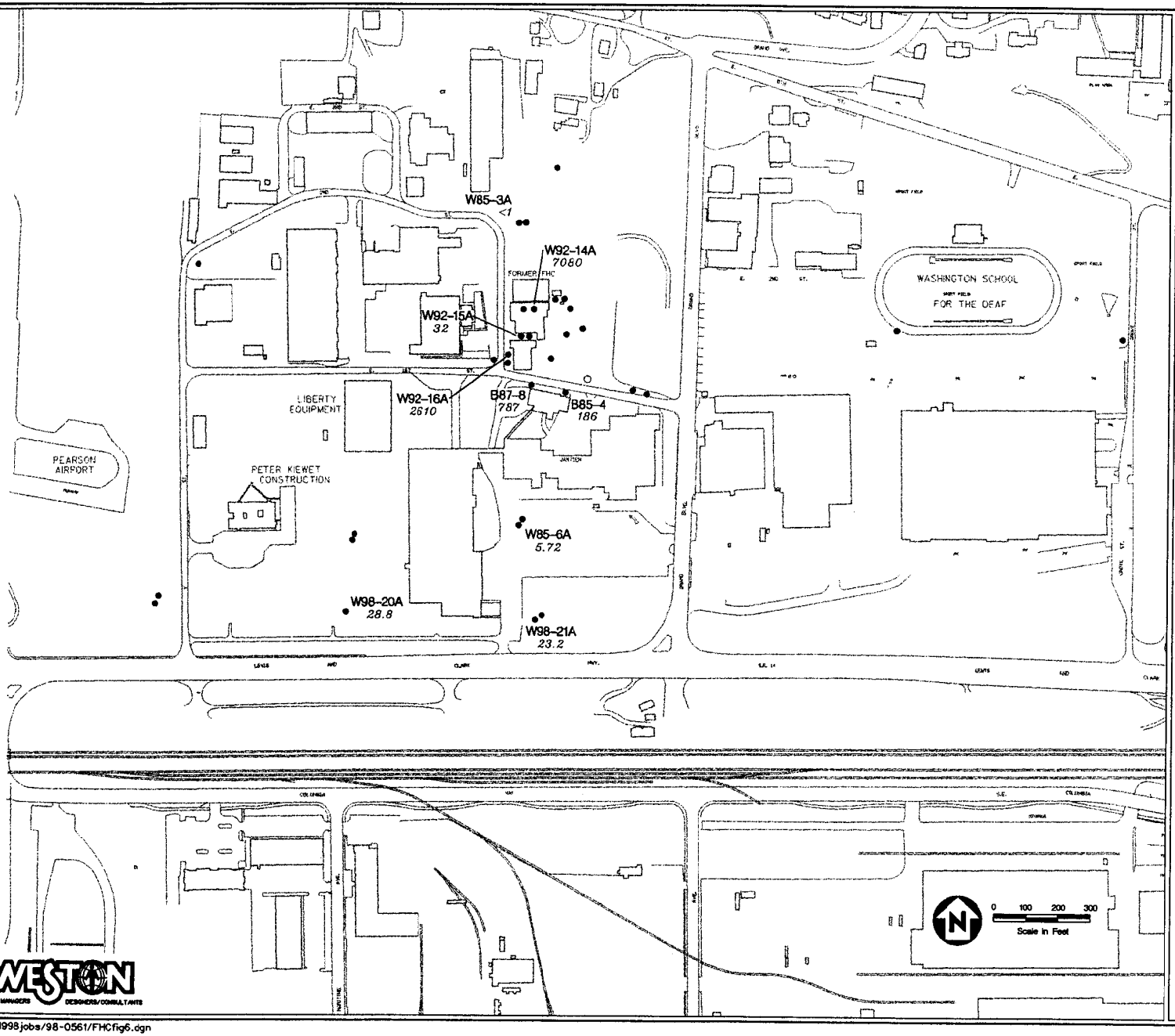

EXPLANATION

W85-3A
<10
• Monitoring Well and June 1998 Filtered Manganese Concentration (ug/L)

Frontier Hard Chrome
Filtered Manganese Concentration
in Groundwater
"A" Zone Aquifer
June 1998

FIGURE
6

WESTON MANAGERS DESIGNERS/CONSULTANTS

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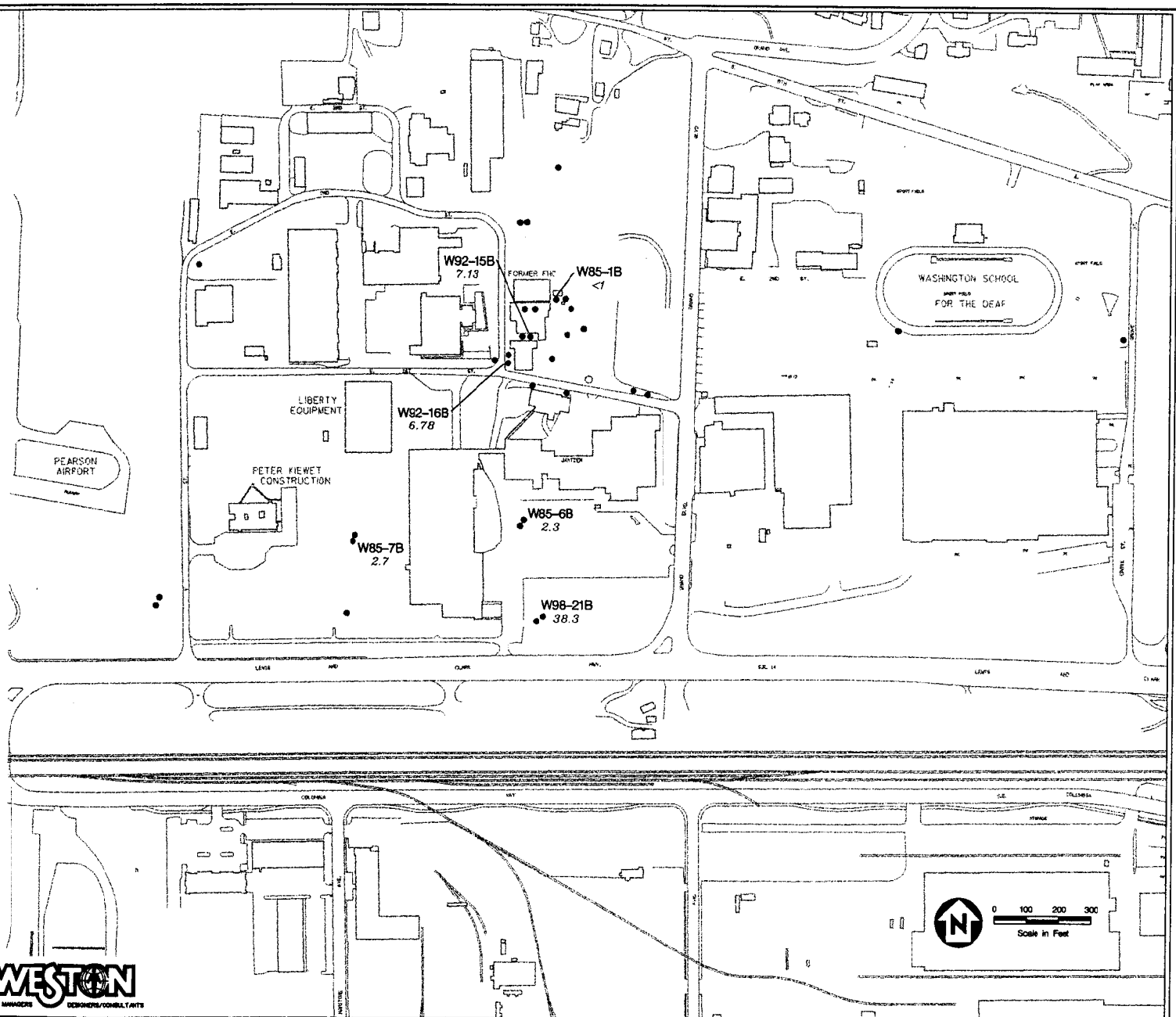

EXPLANATION

W85-7B
<10 • Monitoring Well and June 1998 Filtered Manganese Concentration (ug/L)

Frontier Hard Chrome
Filtered Manganese Concentration in Groundwater "B" Zone Aquifer June 1998

FIGURE
7

WESTON MANAGERS DESIGNERS/CONSULTANTS

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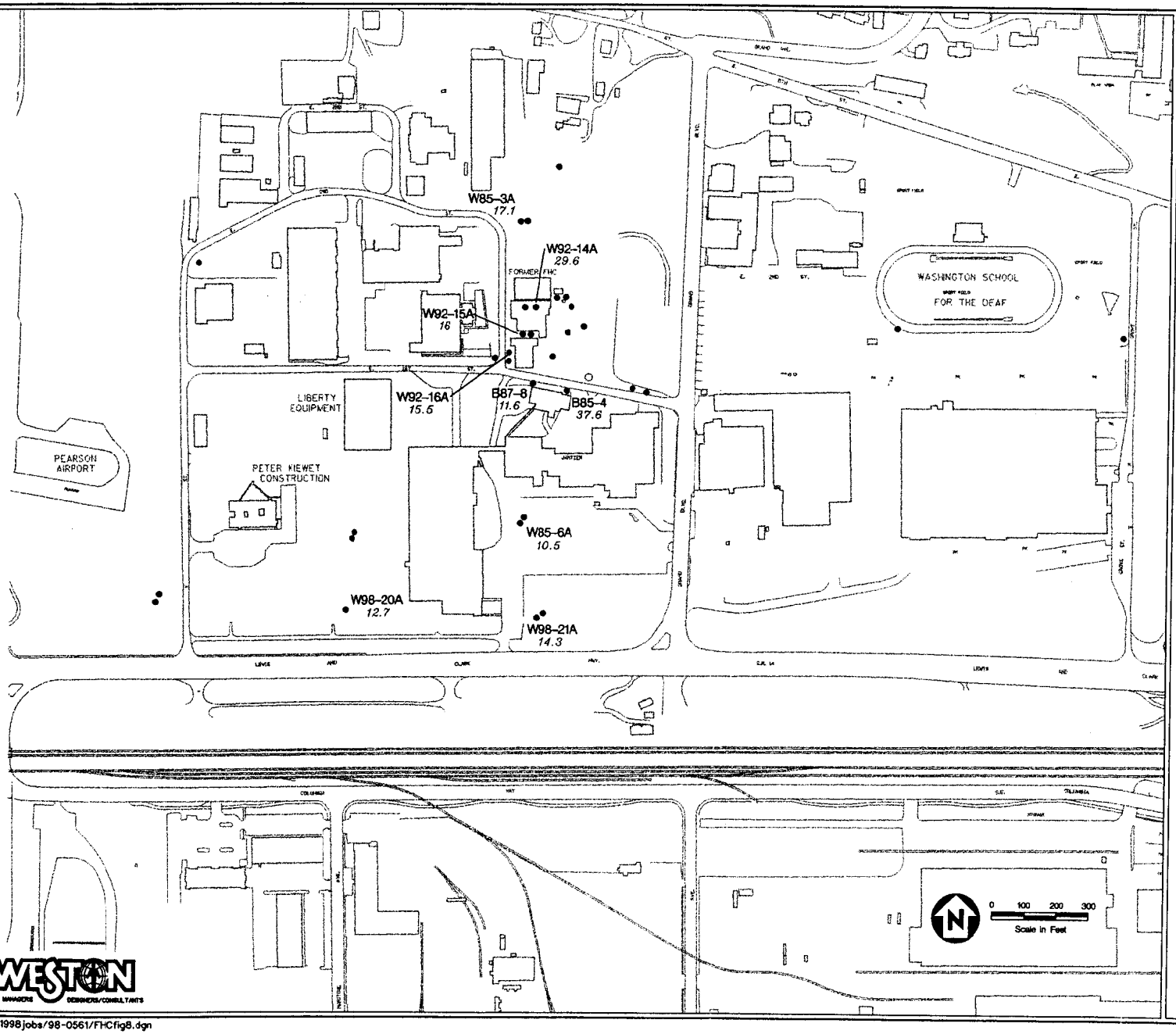

EXPLANATION

W85-3A
10.3 • Monitoring Well and June 1998 Sulfate Concentration (mg/L)

Frontier Hard Chrome
Sulfate Concentration
in Groundwater
"A" Zone Aquifer
June 1998

FIGURE
8

WESTON MANAGERS DESIGNERS/CONSULTANTS

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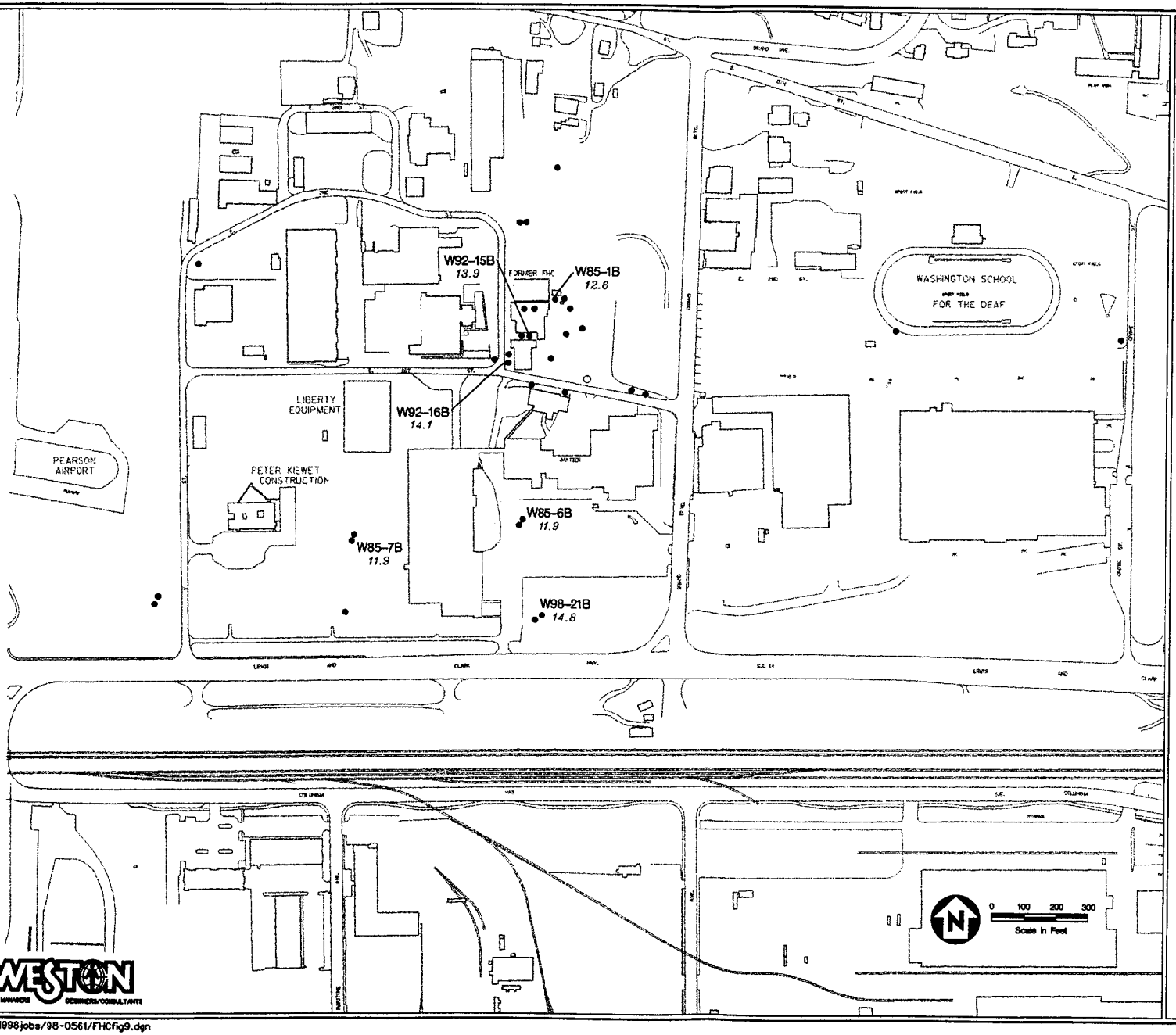

EXPLANATION

W85-7B
10.3 • Monitoring Well and June 1998 Sulfate Concentration (mg/L)

Frontier Hard Chrome
Sulfate Concentration
in Groundwater
"B" Zone Aquifer
June 1998

FIGURE
9

WESTON
MANAGERS ENGINEERS/CONSULTANTS

nfsdir/1998jobs/98-0561/FHCfig9.dgn

TABLES

Table 1—Monitoring Well Construction Details

Station Name	Date Constructed	Ground Surface Elevation (Ft.)	Top of Well Casing Elevation (Ft.)	Depth to Bottom Well (Ft. bgs)	Diameter Well Casing (In.)	Depth to Top Screen (Ft. bgs)	Depth to Bottom Screen (Ft. bgs)	Length Well Screen (Ft.)
W98-20A	5/29/1998	27.64	27.34	27.3	2	22.0	27.0	5
W98-21A	5/27/1998	29.27	29.05	26.3	2	20.7	25.7	5
W98-21B	5/28/1998	29.54	29.27	44.3	2	39.0	44.0	5

Table 2—Monitoring Well Development Summary

Station Name	Total Depth (feet)	Casing Diameter (inches)	Casing Volume (gallons)	Development Volume (gallons)	Post-Development Field Parameters			
					pH	Conductivity (uS)	Temperature (C)	Turbidity
W98-20A	26.43	2.0	2.7	52.0	6.64	238	14.3	Clear
W98-21A	25.15	2.0	2.3	50.0	6.45	239	14.8	Low
W98-21B	41.50	2.0	5.1	76.0	6.63	267	14.6	Clear

Table 3—Groundwater Sample Analysis Summary

Sample Location	Filtered TAL Inorganics	Conventional Anions	Total Organic Carbon
B85-4	X	X	
B87-8	X	X	
W85-1B	X	X	
W85-3A	X	X	
W85-6A	X	X	
W85-6B	X	X	
W85-7B	X	X	
W92-14A	X	X	
W92-15A	X	X	
W92-15B	X	X	
W92-16A	X	X	
W92-16B	X	X	
W98-20A	X	X	X
W98-21A	X	X	X
W98-21B	X	X	X

Table 4—Filtered TAL Inorganics Concentrations in Groundwater (µg/L)—June 1998

STATION ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
B85-4	20 U	45 U	40 U	15.9	1.0 U	2.0 U	48,400	1,520	5.0 U	3.0 U	10 U	25 U	12,400	186	10 U	1,800	100 U	4.0 U	9,420	40 U	3.0 U	4.0 U
B87-8	20 U	45 U	40 U	3.8	1.0 U	2.0 U	24,400	226	5.0 U	3.0 U	10 U	25 U	7,930	787	10 U	870	100 U	4.0 U	9,910	40 U	3.0 U	4.0 U
W85-1B	20 U	45 U	40 U	11.9	1.0 U	2.0 U	29,300	5.0 U	5.0 U	3.0 U	10 U	25 U	9,000	1.0 U	10 U	2,860	100 U	4.0 U	6,450	40 U	7.1	6.4
W85-3A	20 U	45 U	40 U	13.7	1.0 U	2.0 U	34,600	63.3	5.0 U	3.0 U	10 U	25 U	11,100	1.0 U	10 U	1,900	100 U	4.0 U	9,790	40 U	3.0 U	4.0 U
W85-6A	20 U	45 U	40 U	12.6	1.0 U	2.0 U	30,600	71.9	5.0 U	3.0 U	11	25 U	10,100	5.72	10 U	2,080	100 U	4.0 U	7,080	40 U	5.6	4.0 U
W85-6B	20 U	45 U	40 U	28	1.0 U	2.0 U	31,200	13	5.0 U	5.7	10 U	25 U	9,180	2.3	10 U	3,300	100 U	4.0 U	6,880	40 U	8.4	27.5
W85-7B	20 U	45 U	40 U	17.3	1.0 U	2.0 U	29,400	15	5.0 U	3.0 U	21.8	25 U	8,660	2.7	10 U	2,360	100 U	4.0 U	5,690	40 U	4.8	44.4
W92-14A	20 U	170	40 U	66	1.0 U	2.0 U	52,600	23,100	8.2	34.6	10 U	25 U	20,100	7,080	10 U	1,900	100 U	4.0 U	13,000	40 U	3.0 U	17
W92-15A	20 U	45 U	40 U	9.61	1.0 U	2.0 U	36,100	604	5.0 U	3.0 U	10 U	25 U	11,400	32	10 U	3,500	100 U	4.0 U	9,650	40 U	3.7	4.0 U
W92-15B	20 U	45 U	40 U	9.24	1.0 U	2.0 U	30,800	123	5.0 U	3.0 U	10 U	25 U	9,540	7.13	10 U	2,930	100 U	4.0 U	6,760	40 U	8.2	4.0 U
W92-16A	20 U	45 U	40 U	12.9	1.0 U	2.0 U	31,900	25.6	5.0 U	3.0 U	11	25 U	12,800	2610	10 U	1,500	100 U	4.0 U	8,160	40 U	3.0 U	4.0 U
W92-16B	20 U	45 U	40 U	9.95	1.0 U	2.0 U	32,700	78	5.0 U	3.0 U	10 U	25 U	10,100	6.78	10 U	3,110	100 U	4.0 U	6,820	40 U	7.7	4.0 U
W98-20A	20 U	45 U	40 U	14	1.0 U	2.0 U	24,700	7.3	5.0 U	3.0 U	10 U	25 U	8,050	28.8	10 U	2,100	100 U	4.0 U	5,950	40 U	3.0 U	4.0 U
W98-21A	23	45 U	40 U	23.6	1.0 U	2.0 U	30,700	42.3	5.9	3.0 U	10	25 U	9,800	23.2	10 U	2,410	100 U	4.0 U	7,290	40 U	3.6	4.0 U
W98-21B	20 U	45 U	40 U	15.7	1.0 U	2.0 U	32,000	37.3	5.0 U	3.0 U	10 U	25 U	10,100	38.3	10 U	2,890	100 U	4.0 U	7,230	40 U	5.7	4.0 U

U = The analyte was not detected at the stated quantitation limit.

Table 5—Conventional Anion Concentrations in Groundwater (mg/L)—June 1998

Station ID	Bicarbonate (Alkalinity)	Chloride	Nitrate	Sulfate
B85-4	135	3.84	1.23 H	37.6
B87-8	97	1.65	0.122 H	11.6
W85-1B	88.3	5.13	3.58 H	12.6
W85-3A	109	8.08	2.49 H	17.1
W85-6A	104	4.6	1.7 H	10.5
W85-6B	97.8	4.47	2.6 H	11.9
W85-7B	86.8	4.21	2.61 H	11.9
W92-14A	165	11.3	0.111	29.6
W92-15A	122	5.28	2.13	16
W92-15B	94.4	5.29	3.3 H	13.9
W92-16A	128	4.16	0.264	15.5
W92-16B	100	5.31	3.21	14.1
W98-20A	72.4	4.52	3.07 H	12.7
W98-21A	98.4	5.35	2.23 H	14.3
W98-21B	103	5.52	2.42 H	14.8

H = The sample holding time was exceeded. Analytical results may exhibit a low bias.

Table 6—Total Organic Carbon Concentrations in Groundwater (mg/L)—June 1998

Station ID	Total Organic Carbon
W98-20A	1.0 U
W98-21A	1.15
W98-21B	1.39

U = The analyte was not detected at the stated quantitation limit.

Table 7—Field Water Quality Parameters for Groundwater—June 1998

Station ID	Conductivity (µS)	pH	Temperature (C)
B85-4	325	6.41	13.8
B87-8	178	6.72	13.8
W85-1B	160	6.82	13.3
W85-3A	210	6.00	14.1
W85-6A	73	6.63	14.2
W85-6B	72	7.81	14.2
W85-7B	172	6.61	13.9
W92-14A	210	6.30	14.1
W92-15A	120	6.77	14.0
W92-15B	95	6.72	13.9
W92-16A	264	6.61	14.6
W92-16B	260	6.69	14.2
W98-20A	213	6.33	13.9
W98-21A	253	6.33	14.3
W98-21B	262	6.44	13.9

Note: Results for redox and dissolved oxygen were rejected due to inconsistent field instrument readings.